

July 22, 1924.

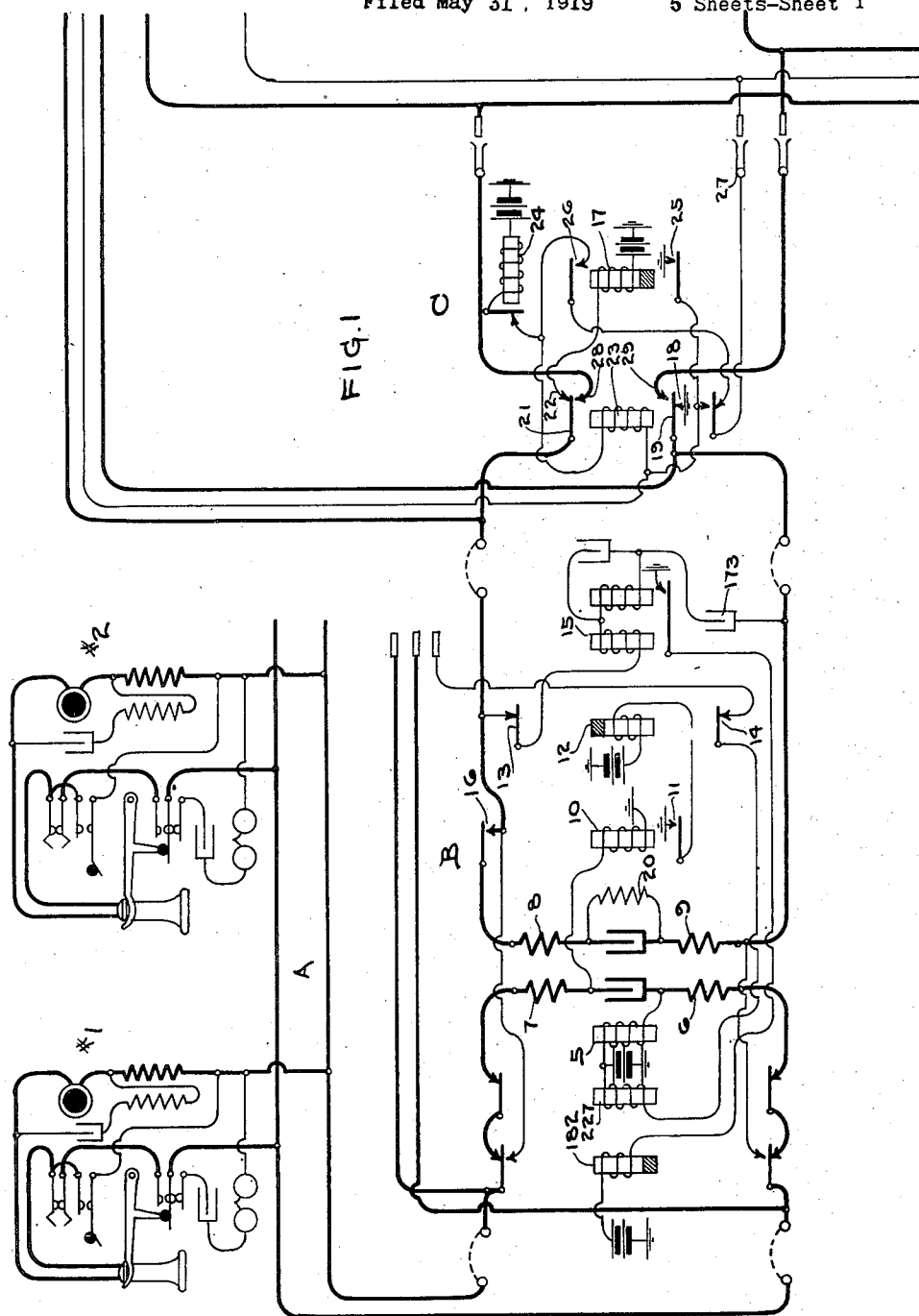
1,502,168

J. WICKS

AUTOMATIC TELEPHONE SYSTEM

Filed May 31, 1919

5 Sheets-Sheet 1



—Inventor—

John Wicks

W. H. Allen Atty:

July 22 , 1924.

J. WICKS

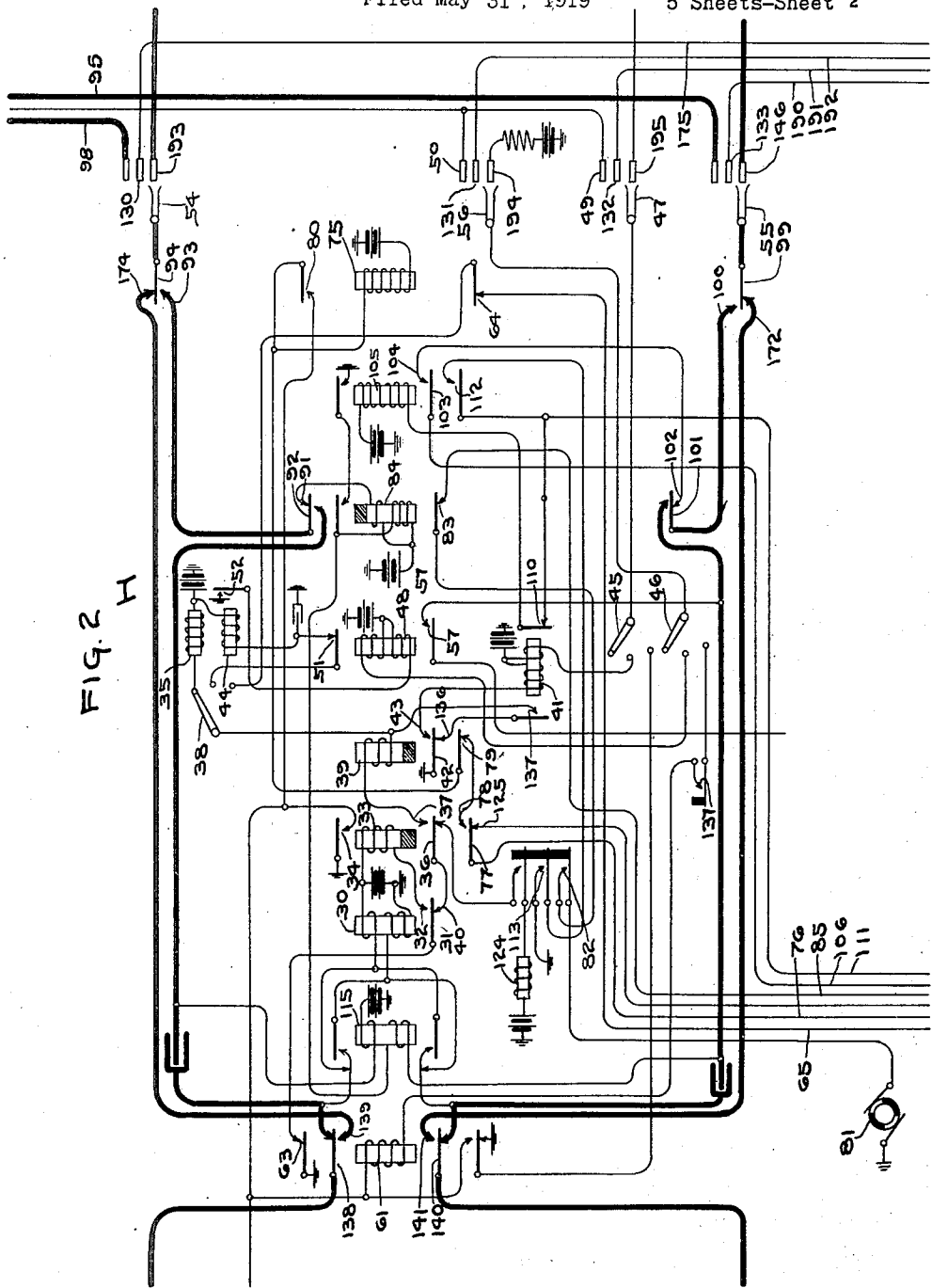
1,502,168

AUTOMATIC TELEPHONE SYSTEM

Filed May 31 , 1919

5 Sheets-Sheet 2

FIG. 2



Inventor
John Wicks
W. H. H. H. H. H. H.

July 22, 1924.

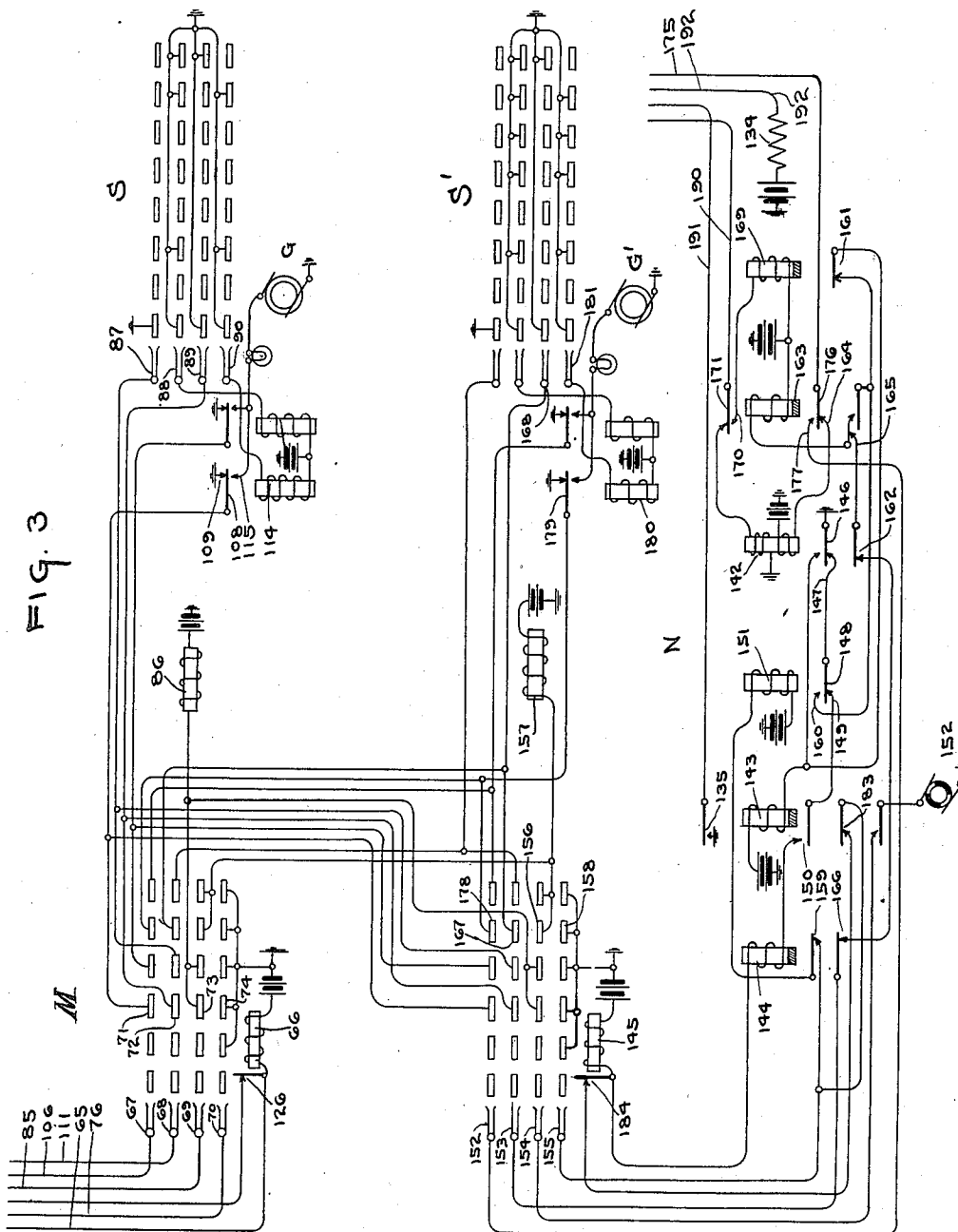
1,502,168

J. WICKS

AUTOMATIC TELEPHONE SYSTEM

Filed May 31, 1919

5 Sheets-Sheet 3



Inventor
John Wicks

J. Wicks

Att.

July 22, 1924.

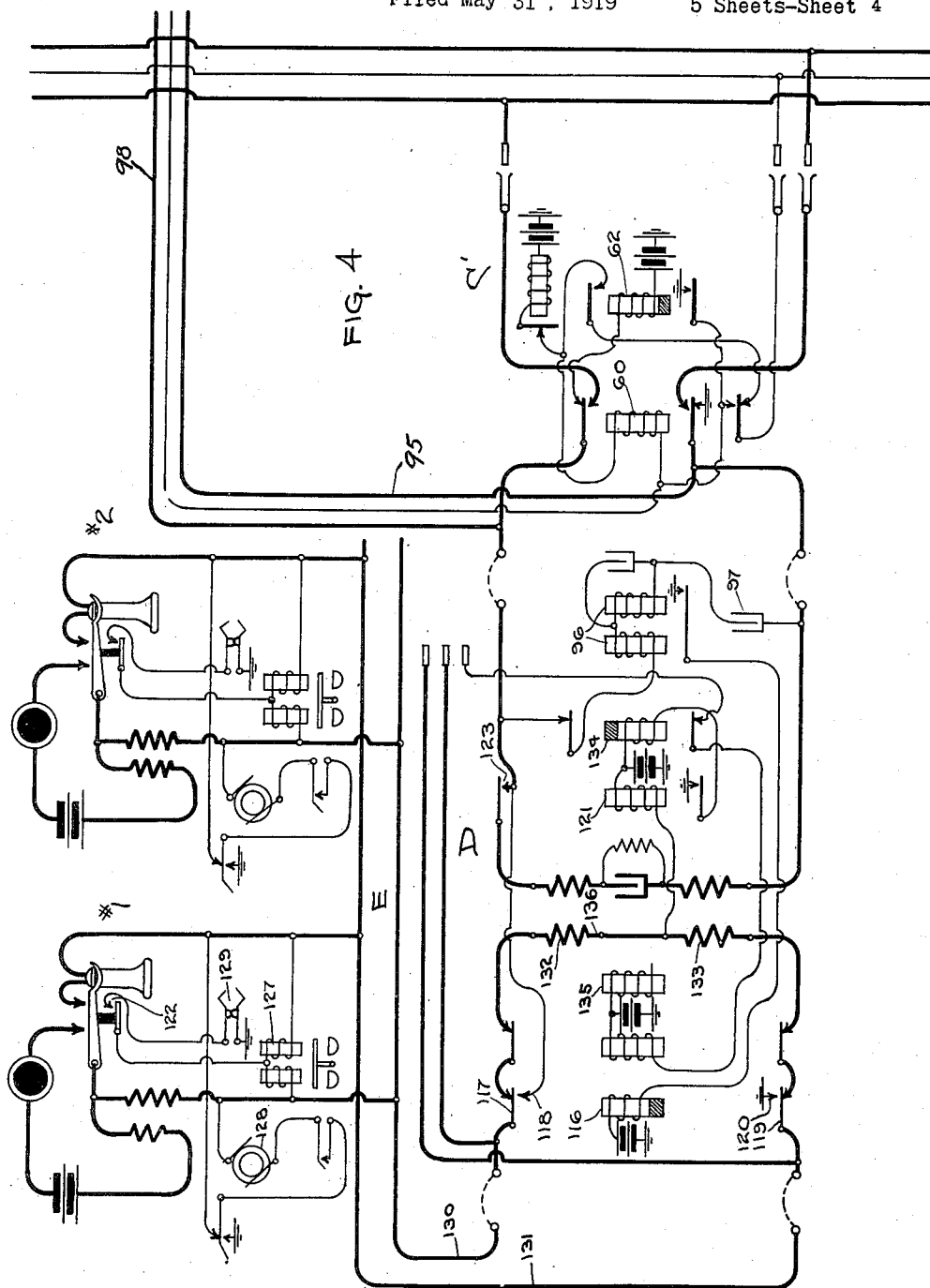
1,502,168

J. WICKS

AUTOMATIC TELEPHONE SYSTEM

Filed May 31, 1919

5 Sheets-Sheet 4



—Inventor—

John Wicks.

W. H. Faler Atty.

July 22, 1924.

1,502,168

J. WICKS

AUTOMATIC TELEPHONE SYSTEM

Filed May 31 1919

5 Sheets-Sheet 5

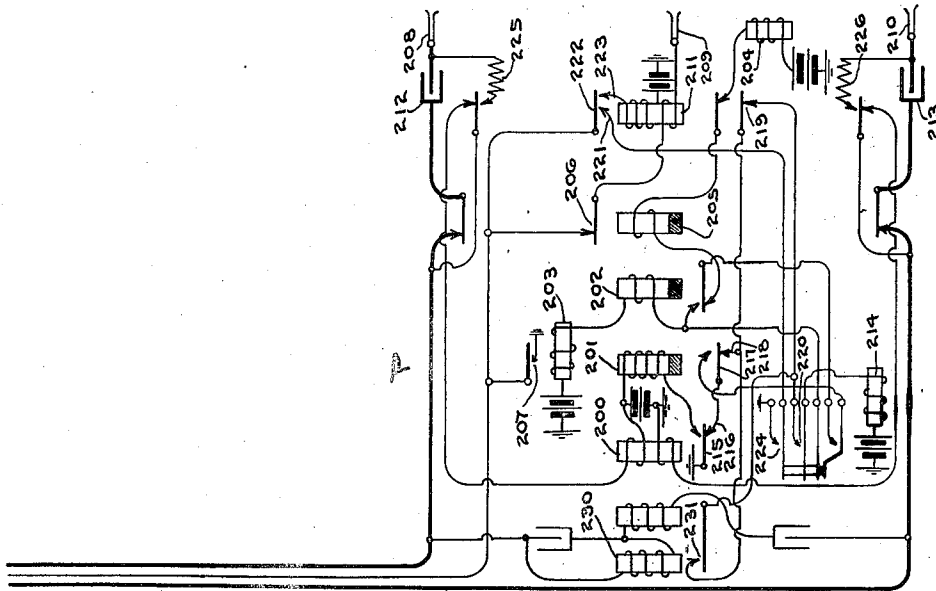
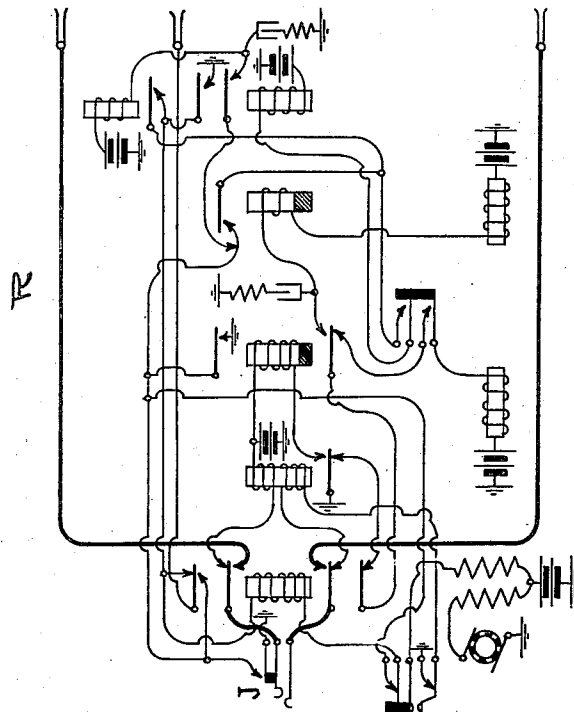


FIG. 5



—Inventor—
John Wicks.

W. H. Wicks Atty:

Patented July 22, 1924.

1,502,168

UNITED STATES PATENT OFFICE.

JOHN WICKS, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY,
OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

Application filed May 31, 1919. Serial No. 300,924.

To all whom it may concern:

Be it known that I, JOHN WICKS, a citizen of the United States of America, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates in general to an improved automatic telephone system and relates more specifically to an improved type of apparatus for use in a telephone system which is to serve as a community automatic exchange. By community automatic exchange is meant that type of exchange or system which is adapted to give service to a community in which there may be various classes of lines each desiring to have access to all the other lines and perhaps through an operator or automatically to a second community or main exchange. The types of lines usually found in a community exchange are the single station standard telephone line, the farmer lines or rural lines, which are sometimes a relic of the manual systems and have long high resistance lines leading to the exchange with sometimes as many as ten or twelve stations for each line which must each be signaled by a code, also there may be lines of the old magneto type. I have shown in this application an exchange which is adapted to take care of these various classes of service by a group of standard switches, that is, the standard lines of the two wire type have direct access to the central exchange switches in the regular manner, while the other lines which are operated in any peculiar manner are provided with a sort of translating or standardizing device which makes it possible for all lines to use the same type of central exchange switches, which switches will operate in a standard manner regardless of the type of lines used in the exchange. Among the objects of my invention are, therefore, to provide improved repeaters for insertion in the substation lines to trans-

late impulses received from telephone lines over a simplex circuit into impulses over two sides of a line in series. Also to provide a repeater of this type which is especially adapted for use in a ring back system so that a substation on a party line may call another substation on the same line and may ring back through the repeater which is so arranged that the repeating coil and the various relays are cut out to provide a straight metallic circuit for signaling. Another object of the invention is to provide improved switches for code ringing either to the calling or called line, for use with rural lines having a large number of stations on the line.

In the drawings I have shown two of the lines of a community automatic exchange with the repeaters associated therewith, together with the central exchanges switches necessary for calling between the various types of lines, and for calling back on a party line. In the drawings:

Fig. 1 shows a line which may have a number of stations thereon, only two of which are shown. This line terminates in a repeater B which is inserted in the line ahead of the line switch C of that line.

Fig. 2 shows a rural connector switch H having a code selector M, (Fig. 3), and a code ring back switch N (Fig. 3), associated therewith.

Fig. 4 shows another line in the system, having two stations of the magneto type, the circuits of which are arranged for dialing over a simplex circuit. The line shown in this figure also has a repeater D and a line switch C' individual thereto. The line switch C' also has access to the connector H (Fig. 2) in common with the line switch C (Fig. 1).

Fig. 5 shows a special test selector R and a test connector P for use in testing the various lines in such community exchange which switches will be further explained hereinafter.

I will now explain my invention more in

detail by referring to the drawing and describing the operation of the various switches when one subscriber calls another. Let us assume for the purpose of this illustration that the subscriber number one on the line A (Fig. 1) desires to call the subscriber number 2 on the line E (Fig. 4). When the subscriber #1 (Fig. 1) removes his receiver to initiate a call a circuit is closed from battery through coil 5, winding 6 of the repeating coil over the line A to and through the substation circuits at station #1, and back over the other side of the line through the winding 7 of the repeating coil and relay 10 to ground. Relay 10 energizes over this circuit to close the springs 11 in the circuit of relay 12 which also energizes to open the springs 13 and 14 to open the circuit of special relay 15 and the private normal conductor. Relay 10 also closes the springs 16 to complete the circuit of the line relay 17 of the line switch C, from ground through springs 18 and 19, winding 9 of the repeating coil, resistance 20, winding 8 of the repeating coil, springs 21 and 22, and through relay 17 to battery. Relay 17 operates in the usual manner to close a circuit including high resistance relay 23 and rotary magnet 24 in series at springs 25, and also prepares a circuit at springs 26 for the rotary magnet 24 direct to the private wiper 27. Now, if the line switch is standing with its wipers resting on a busy trunk line, there will be a ground present on the test contact thereof which will now complete the last mentioned circuit to cause the operation of rotary magnet 24 to step the wipers of the switch to the next set of contacts in its bank. This operation of magnet 24 will continue in the manner of a buzzer as long as the wiper 27 continues to find grounded contacts of busy lines. As soon as an idle trunk line is reached upon which there is no ground present, then relay 23 will be no longer shorted and will energize over the series circuit with magnet 24 but its high resistance will prevent the energization of magnet 24. Relay 23, upon energizing, disconnects the line relay and ground from the line circuit and closes the springs 21 and 28 and springs 19 and 29 to cut the line through to the trunk line associated with the seized set of contacts which trunk line we will assume in this case to be the trunk line leading to the connector switch H (Fig. 2). As soon as the connection is thus extended the circuit of line relay 30 of the connector switch H is closed, said circuit including the windings 8 and 9 of the repeating coil in the repeater B, the springs 16 controlled by the line relay 10 of repeater B, and the line wipers of the line switch C. Relay 30, upon energizing, closes a circuit at springs 31 and 32 to energize slow relay 33, which in turn supplies ground through springs 34 to the release trunk to

maintain the switch C in operated position, prepares a circuit for the vertical magnet 35 at springs 36 and 37 through the side switch wiper 38 in first position, and through the slow-acting series relay 39.

The calling subscriber will now operate his calling device in accordance with the first digit of the called subscriber's number. Each time the calling device is operated, the circuit of the line relay 10 of the repeater B is opened a number of times. Relay 10 opens the circuit of the line relay 30 of the connector H a corresponding number of times at the springs 16, and of relay 12 at springs 11. Relay 12 being slow acting maintains its armature in attracted position. Relay 30, however, operates to complete, at springs 31 and 40, the circuit including relay 39 and magnet 35. Magnet 35 operates to step the wipers of the switch to the desired level of the bank in which level is located the called subscriber's line. Relay 39 energizes in series with the vertical magnet and remains energized during this series of impulses to hold the private magnet 41 energized over a circuit extending from ground through springs 42 and 43, and through the left hand winding of magnet 41 to battery. Soon after the impulses for the first digit cease the relay 39 will fall back and open the circuit of the private magnet 41. Magnet 41, being of the usual type of private magnet well known in the Strowger switches, allows the side switch wipers to pass to second position. The wiper 38 opens the circuit of the vertical magnet 35 and prepares the circuit of the rotary magnet 44. The side switch wiper 45 prepares a circuit for the right hand winding of private magnet 41 to the private wiper 47, and the wiper 46 prepares a circuit for the upper winding of the busy relay 48.

All the contacts similar to 49 and 50 in the bank of the connector H which lead to individual lines are connected together and grouped together in one or more levels of the said connector. Assume now that the first digit caused the wipers to be raised opposite a level in which the contacts 49 and 50 and other similar test contacts are located. Now, when the calling subscriber operates his dial for the next digit, the line relay 10 of the repeater B again controls the circuit of line relay 30. Relay 30 in this case completes a circuit, each time it de-energizes, for the rotary magnet 44 in series with relay 39 and with springs 51 of relay 48. Each time the magnet 44 operates it rotates the wipers one step toward the called line and also closes a circuit for the lower winding of relay 48 at springs 52. Relay 48 therefore energizes momentarily with each impulse and opens the circuit of the rotary magnet at springs 51 but has no effect at this time. Relay 39 again holds the private

magnet 41 energized during impulses and for a short time thereafter. As soon as the wipers 54, 55, 56 and 47 reach the called line the impulses cease and in case the called line is busy and a ground is present on the test contacts 49 and 50 thereof, then one circuit will be completed for the right hand winding of private magnet 41 through side switch wiper 45 and wiper 47, and another circuit will be completed for the upper winding of the busy relay 48 through side switch wiper 46 and private wiper 56. Magnet 41 will therefore be held energized to hold the side switch wipers in second position and relay 48 will operate to connect the busy tone to the calling line through springs 57, and to open the circuit of the rotary magnet 44 at springs 51.

The calling subscriber must in this case hang up his receiver and release the connection or wait until the line becomes idle. If the called line is idle however, and no ground is present on the test contact thereof, then when the wipers 56 and 47 meet said test contacts, relays 41 and 48 will be no longer energized and magnet 41 will fall back and allow the side switch to pass to third position. Side switch wiper 45, upon reaching third position connects ground direct to the wiper 47 to energize the bridge cut off relay 60 of the called line, and short circuits the relay 61 to prevent its energization. The cut off relay 60, (Fig. 4), upon energizing, disconnects the line relay 62 from the called line but does not cut the line through to the wipers.

The line E being a party or rural line and having a plurality of stations bridged across it, then the calling subscriber must send another digit to the connector H to operate its associated code selector M to pick out the proper code to signal the desired subscriber. It will be understood that in a system of this sort, there are a number of code interrupters S, S', etc., each being capable of supplying two or more codes, that is, if either of the codes 1—1—1 or the code 1—1—2 are desired, then the code selector M will be operated to its third or fourth sets of contacts leading to the code interrupter S, while for the two codes 1—1—3 or 1—1—4 the code interrupter S' will be selected, and so on, so that there are a number of code interrupters each supplying two codes or more if desired, and there will be as many sets of contacts in the bank of the code selector M as there are codes or parties on the largest party line. The code interrupters S, S', etc., are common to the connectors.

As the calling subscriber sends the impulses of the final digit, relay 10 of the repeater is again operated to control relay 30. Relay 30 in this instance controls a circuit which extends as follows: ground through

springs 63, springs 31 and 40, springs 36 and 37, relay 39, side switch wiper 38 in third position, springs 64, conductor 65, and magnet 66 to battery. The magnet 66, (Fig. 3) is operated a number of times to step the wipers 67, 68, 69 and 70 to a set of contacts in their bank corresponding to the code desired. Assume that the digit called is 3, then the wipers step to the contacts 71, 72, 73 and 74 and come to rest thereon. As soon as the wiper 70 meets the grounded contact 74 and relay 39 falls back a circuit is closed for the wiper cut on relay 75 (Fig. 2) as follows: ground through contact 74 and wiper 70, conductor 76, springs 77 and 78, springs 79, and relay 75 to battery. Relay 75 operates to open the circuit of the stepping magnet 66 at springs 64, closes a holding circuit for itself at springs 80, and cuts the ringing circuit through to the line wipers 54 and 55 and therefore to the called line. Wiper 69 (Fig. 3) upon reaching contact 73, closes a circuit from ground through interrupter 81, (Fig. 2), off normal springs 82, springs 83 of ring cut off relay 84, conductor 85, wiper 69, contact 73, and rotary magnet 86, to battery. The intermittent operation of the magnet 86 causes the wipers 87, 88, 89 and 90 to move over the contacts in their banks in a rapid step by step manner. The energization of relay 75 of connector H closes a ringing circuit for the called line which extends from battery through the upper winding of the ring cut off relay 84, springs 91 and 92, springs 93 and 94, wiper 54, conductor 98 to Figure 4 over said conductor through a condenser 97 and special alternating current relay 96, back over conductor 95, wiper 55, springs 99 and 100, springs 101 and 102, through a pair of springs 103 and 104, which will be closed by relay 105 in a manner to be explained, conductor 106, wiper 67, contact 71, to ground through springs 108 and 109, while relay 114 is deenergized, and to the ringing generator G where said relay energizes. The relay 105 will also be energized by a circuit from battery through said relay, springs 110, conductor 111, wiper 68, contact 72, wiper 89, and as soon as the magnet 86 steps the wiper 89 onto the first contact it will meet ground. Relay 105 will therefore energize and lock to ground through springs 112 and off normal springs 113, and will also close the springs 103 and 104 in the ringing circuit. Now, as the wiper 90 of the code interrupter steps over its associated contacts, the circuit of relay 114 will be closed on every other contact to connect the generator G to the circuit extending through springs 115 and 108, contact 71, wiper 67, conductor 106, and over the previously traced circuit to and through the alternating current relay 96 and back to battery through the winding of relay 84, and also to a branch circuit which

extends, as will appear presently, over the line conductor 130 to the called station, returning via line conductor 131 to ground at spring 120. The station on the called line whose code is 1—1—1 will answer the call and upon lifting his receiver will close a circuit for relay 84 at springs 123 by energizing relay 121. Relay 84 energizes to open the circuit of the stepping magnet 86 at springs 83, opens the springs 92 and 91 and 101 and 102 in the ringing circuit and locks itself energized. When the springs 92 and 101 meet their front contacts, the circuit of the back bridge relay 115 is completed in series with the right hand winding of the repeating coil associated with the called line, and the said relay 115 will therefore energize to reverse the connections of the line relay 30 to the calling line. When the relay 105 connected generator current to normal conductor 95 of the called line, said alternating current first passed through the alternating current relay 96 which is individual to the line E (Fig. 4). Relay 96 energizes with the first impulse of current to close the circuit of the slow relay 116 and maintain said relay energized during ringing. Relay 116 upon energizing, cuts out the windings of the repeating coil associated with the repeater D at springs 117 and 118 and springs 119 and 120, thereby providing a clear metallic circuit for ringing current to pass through to the called line. When the called subscriber answers the circuit of the line relay 121 of the repeater is closed at the springs 122 of the called station during the first silent interval, relay 116 having deenergized and relay 121 operates to close the springs 123 to complete the circuit of relay 84 and later of relay 115, as previously mentioned.

Conversation may now proceed in the usual manner and when completed, the calling subscriber restores his receiver to open the circuit of the relay 10 which in turn opens the circuit of the relay 30 of the connector at springs 16. Relay 30 falls back and opens the circuit of slow relay 33 which in turn falls back to remove ground from the holding circuit of the line switch C and close the circuit of release magnet 124. Magnet 124 operates to release the connector H which operation restores the off normal springs. The closure of springs 77 and 125 by relay 33 completes a circuit for the rotary magnet 66 from ground through contact 74, wiper 70 and including the interrupter springs 126 of the magnet itself. Magnet 66 therefore operates in the manner of an interrupter to rotate its wipers off the bank and in readiness for the next call. It will be understood that the wipers of the code selector M and the code interrupter are of the double end type so that as one end moves off the last contact the other end stands in readiness to step onto the first contact.

It will also be understood that to call any other subscriber on a rural or multiparty line the procedure is the same except that different codes are selected. For instance, if the wipers of the code selector Fig. 3 are stepped to their fourth set of contacts then the code associated with the wiper 88 of the code interrupter will be selected, this code being 1—1—2 rings. Furthermore, if other codes are desired then the code selector will be stepped to a contact leading to another code interrupter which has two other codes associated with it. More than two codes may be associated with each code interrupter if desired by providing more sets of contacts in its bank and more wipers and relays.

It will be understood that the connector switch H must be able to make connection with party lines as described, with single station lines, and must also have access through some one of its levels to trunk lines leading to another or main exchange in order to meet the requirements of community exchange systems.

I will next describe the method by which any of the subscribers on the line E (Fig. 4) may seize and operate the connector H (Fig. 2).

It will be noticed that the substations of the line E are of a different type than the stations on the line A, Fig. 1. The substation 1, for instance, is of the magneto type of substation having a ringer 127 bridged across the line circuit and a hand generator 128 of well known type also in bridge of the line. In a line of this type the wires leading to the central station are usually of such high resistance as to render two wire dialing such as is used by the stations on line A (Fig. 1) impractical, and the dialing circuit for station #1 extends from ground through the calling device springs 129, springs 122, windings of the two coils of the ringer in parallel, line wires 130 and 131 in parallel, windings 132 and 133 of repeating coil in parallel, and through relay 121 of the repeater D to battery. This relay 121 corresponds in action to the line relay 10 of the repeater B (Fig. 1) and operates in a similar manner to energize relay 134 to remove the windings of relay 96 from across the line and closes the circuit of the line relay 62 of the line switch C' at springs 123. Thus the line relay 121 is controlled over a simplex circuit by the operation of the calling device springs 129, and the said relay 121 controls first the line switch C' and then the connector H in accordance with the digits of the called number to find the called line. It will be understood that the operation of the connector H or of the connector similar to H which is seized is exactly the same in this case as when seized by the line switch C of a two wire type of station. It will

also be understood that the repeaters B and D are for improving the calling impulses from a line such as A or E which is of too high resistance to properly operate the line relay of the connector H direct and are also in some instances such as in the case of the repeater D, for translating impulses over a simplex circuit into impulses over two sides of a line in series. Should the line E be changed over to two wire substations, then it will be seen that the repeater D need only be changed by connecting the coil 135 to the terminal 136, by inserting a condenser between the windings 132 and 133 of the repeating coil, and by connecting the upper terminal of relay 121 to ground instead of battery. Also if the line A should be shortened so that it would be of a lower resistance, then the repeater B could be disconnected at the dotted jumpers shown and the line A connected direct to the line switch C.

I will now describe the operation of the switch H and its associated apparatus when a subscriber (for instance the subscriber #1 on line A) starts a call to the subscriber #2 on his own line. In this case the call is extended to the connector H in the same manner as before described. In this case, however, assuming that the ring back switches such as N accessible to the connector are located in the second level of the connector H, the subscriber calling will therefore operate his calling device for the digit 2 to step the wipers 54, 56, 47 and 55 to the second level of the bank in the same manner before pointed out by means of line relay 30 and vertical magnet 35, thereby causing the private magnet 41 to step the side switch wipers to second position, and causing the off normal springs 137 to be closed. As soon as the side switch wipers reach second position a digit will be sent such as one if the whole level consists of ring backs or 2 if the first ring back in the level is on the second contact. In any case the relay 30 is again operated to control the rotary magnet 44 to step the wipers to the first set of contacts leading to a ring back switch N (Fig. 3). When the wipers 54, 56, 47 and 55 meet the contacts 130 to 133, inclusive, of the ring back, the wiper 56 meets battery through the resistance 134 which short circuits the upper winding of relay 48. If the first switch N is busy, then ground through springs 135 will be present on contact 132 and will energize the right hand winding of private magnet 41 to hold the side switch in second position. Now, as soon as the relay 39 falls back, another circuit will be closed for the rotary magnet 44 from ground through springs 42 and 136, springs 137, wiper 38, springs 51, and magnet 44 to battery. Each time magnet 44 operates it energizes relay 48 which in turn opens the circuit of mag-

net 44 at springs 51. The alternate operation of relay 48 and magnet 44 continues until an idle trunk line is reached, at which time private magnet 41 will fall back and allow the side switch to pass to third position. As soon as the wiper 46 reaches third position the circuit of switching relay 61 is closed from ground through said relay, springs 137, wiper 46, wiper 56, contact 131, and resistance 134 to battery. Relay 61 energizes over this circuit to disconnect the line relay 30 and all other relays from the trunk circuit and to connect the trunk circuit through the springs 138 and 139 and springs 140 and 141, and through back contacts of springs of relay 75 direct to the wipers. Relay 61 also opens the springs 63 to prevent the release of switch H when the line relay falls back and locks itself energized from ground which is supplied from relay 143 of switch N. As soon as this circuit is closed a circuit is completed for the line relay 142 of the ring back N in series with the extended line circuit and with the springs 16 of the line relay 10 of the repeater of line A. Relay 142 energizes to close a circuit for slow relay 143 which in turn energizes to supply a holding ground to relay 61 of the connector H and prepares a circuit for the relay 144 and the rotary magnet 145 of the code selector.

The calling subscriber now operates his calling device to select the proper code to signal the called party. Relay 142 in operating closes a circuit a number of times extending from ground through springs 146 and 147, springs 148 and 149, springs 150, relay 144, and rotary magnet 145 to battery. Relay 144 operates to hold the circuit of relay 151 and of interrupter 152 open during impulses and magnet 145 operates to step the wipers into engagement with the proper set of contacts leading to the code desired, which may be on any of the interrupters S, S', etc. Assume the code in this case to be 1-1-3, then the wipers of the code selector move to their fifth set of contacts, thereby picking out the lower pair of wipers on the code interrupter. Now, a circuit is closed from interrupter 152, springs of relay 143, wiper 154, contact 156, and magnet 157 to battery. Magnet 157 therefore operates to step the wipers of the code interrupter S' over its contacts. Also as soon as relay 144 falls back a circuit is closed from ground through contact 158 and wiper 155 through springs 159 and relay 151 to battery. Relay 151 energizes to open the springs 148 and 149 and to close the springs 148 and 160 to prepare a new holding circuit for the relay 143 to be completed later. Nothing is done by this switch N until the calling subscriber restores his receiver to the hook as is common practice in ring back calls. When this is done the circuit of the

line relay 10 is opened by the switch hook springs and relay 10 deenergizes to open the circuit of the line relay 142 of ring back N. The switches N, H and C are not restored at this time as relay 143 stays energized and holds ground on the release trunk. The line relay 142 on falling back closes a circuit from ground through springs 146 and 147, springs 148 and 160, springs 161, and relay 143 to battery. Relay 142 also closes springs 162 which complete a circuit from battery through relay 163, springs 164 and 165, springs 162, springs 166, wiper 153, contact 167, wiper 168 of the code interrupter, and through the first contact of its bank to ground. Should the subscriber delay in hanging up his receiver, then this circuit would not be closed until the code interrupter again reached the first or last contacts of its bank to prevent the starting of the ringing in the middle of the code. Relay 163 energizes over this circuit, and locks itself energized through springs 160 and 148, and springs 146 and 147. Relay 163 also disconnects the line relay 142 from the extended trunk circuit and closes a ringing circuit which extends as follows: from battery through relay 169, springs 170 and 171, contact 133 and wiper 55 of the switch H, springs 99 and 172, springs 141 and 140, line wiper of line switch C and its contact, springs 29 and 19, condenser 173, relay 15, springs 13, springs 21 and 28, upper wiper of switch C, springs 138 and 139, springs 174 and 94, wiper 54 and contact 130, conductor 175, springs 176 and 177, wiper 152 of the code selector, contact 178, spring 179, alternately to ground through the back contact of said spring and to generator G'. Relay 180 is intermittently energized in accordance with the code 1—1—3 as the wiper 181 passes over its bank contacts to signal the called party. Relay 15 of the calling line operates to close the circuit of relay 182 which gives a clear circuit to the ringing current excluding the repeating coil. Now, when the called party answers by removing his receiver a circuit is closed for the relay 169 for direct current, and this relay energizes over the previously traced circuit to open the springs 161 in the holding circuit of relay 143. Relay 143 deenergizes to open the circuit of magnet 157 and interrupter 152, and closes the springs 183 which completes a circuit for magnet 145 through springs 184 and wiper 155 of the code selector to ground. The relay 15 of the repeater of the calling line opens the circuit of relay 182 as soon as ringing current is cut off and restores the line relay 10 to its connection with the calling line after a short interval. The magnet 145 operates as an interrupter to rotate the wipers 152—155 inclusive, back to normal position when the circuit of said magnet is opened by wiper

155. Relay 143 also opens the springs 150 in the circuit of relay 144 which was already open at springs 148 and 149. As soon as the wipers of the code selector come to normal the circuit of the relay 151 is opened by wiper 155 and said relay falls back to remove the holding ground from relay 163 which in turn falls back to restore the line relay 142 to the talking circuit. In the meantime, however, as a result of the deenergization of relay 143 the springs 135 were opened to remove ground from the holding circuit to switches C and H. These two switches release and break the connection to the ring back switch N. If, however, the line relay 10 has energized prior to the deenergization of relay 143 and has closed the springs 16, then the switch C may not release but the switch H will release over a circuit from ground through springs 63, springs 31 and 40, springs 36 and its back contact, and off normal springs through the release magnet 124 to battery. In either case the switch C will take the trunk to the switch H again due to the closure of springs 16 which will again operate said switch. The calling and called subscribers find talking battery through the windings of relays 10 and 5 and may converse. When conversation is terminated the restoration of the receivers of the calling and called lines causes the release of the switch C.

It will thus be seen that a subscriber may call the ring back number in the connector, then pick out a code on one of the code interrupters S, S', etc., and may then release the connection to the ring back by the response of the called subscriber and converse over the line direct. The connector switch H (Fig. 2) also has access through certain levels to trunk lines leading to another or main exchange. One of these trunk lines would lead from contacts such as 193, 194, 195 and 196 in the banks of the connector. The contact 194 is shown connected to battery through a resistance and the operation of the switch H in calling such a trunk line to the other exchange would be the same as when calling a ring back switch with automatic rotation in search of an idle trunk and relay 61 would energize to switch the circuit through clear metallic through the switch H.

In Fig. 5 I have shown a test selector and a connector. The test selector R is of a standard type of selector except that it is shown accessible through a jack J. This selector may be used by an attendant in the exchange or by an operator at the main exchange to call through connectors such as H to a test connector such as P (Fig. 5). This test connector has a special set of banks leading to the various lines in the exchange. I have shown in Figs. 1 and 4 two sets of the contacts of such banks, one for the line

A and another for the line E. It will be seen that when testing any of the lines for trouble, etc., the operator or attendant will desire to have direct access to that line without having to go through the repeating coil of the individual repeater thereof. The multiples of the lines in the test connector therefore are taken from a point between the substations and said repeater, and means is provided for disconnecting the repeater over the private normal. I will explain the operation of the test connector only in general. When connection is made with this test connector by a connector such as H, through a set of contacts similar to the contacts 193—196 inclusive, in which the contact corresponding to contact 194 leads to battery, relay 61 of the connector will therefore energize to switch through and line relay 200 of connector P will energize in series with the calling device at the operator's position. Line relay 200 is energized to energize relay 201 to prepare the circuit of relay 202 and vertical magnet 203. When the digits are called relay 200 operates first to control the vertical magnet 203 and then when relay 202 falls back in the pause between digits, the operating circuit is shifted to the rotary magnet 204. When the last digit is called, the relay 205 and rotary magnet 204 are operated to step the wipers to the called line, after which relay 205 deenergizes to close springs 206. Relay 201, upon energizing, placed ground on the release trunk to hold relay 61 of the connector H energized. If the called line is busy then relay 211 will not energize because the private normal conductor is open at springs 14 of relay 12. The operator if desired may converse with the busy called subscriber through the condensers 212 and 213 and the back contacts of the springs of relay 205. The operator may then release if desired by opening the line and deenergizing relay 200 which closes a circuit for release magnet 214 through springs 215 and 216, springs 217 and 218, springs 219, off normal springs 220, and magnet 214 to battery. If, however, the called line be idle then the relay 211 will energize from ground through springs 207 of relay 201, lower winding of relay 211, wiper 209, and bridge cut off relay 227 of the called line to battery. Relay 227 of the called line opens the line circuit to the repeating coil and to the line relay of the line A. Relay 211 on energizing opens the circuit of magnet 204, opens the springs 219 in the circuit of the release magnet, locks itself to ground through its upper winding, through springs 221 and 222, springs 223, and springs 224 to ground. Relay 211 also short circuits the condensers 212 and 213 in the talking circuits by the resistances 225 and 226, and removes the line relay 200 from the talking

circuit. Relay 200 falls back and opens the circuit of relay 201, relay 201 falls back, opens the springs 207, but does not close the circuit of the release magnet 214, which is held open at springs 219. The ground through off normal springs 224 and springs 223 and 222 holds the switches H, etc., up over the release trunk. It will be seen now that the operator may perform any of the necessary tests desired over a clear metallic circuit.

After all tests are completed the operator is provided with a special relay 230 for releasing the extended connection as it will be seen that merely opening the line will not release the switches. When the operator desires to release she throws her ringing key to energize the tuned relay 230. Relay 230 energizes and closes the springs 231 which complete a circuit from ground through springs 215 and 216, springs 217 and 218, springs 231, springs 220, and magnet 214 to battery. Magnet 214 releases the switch P and thereby restores the off normal springs, the springs 224 removing ground from the release trunk to release the switches ahead.

It will be seen from the foregoing that I have provided a very flexible system of a community exchange and one which is especially adaptable to a small rural community exchange in which there may be almost any number of different classes of lines and trunks in which the same set of main exchange switches are used in all calls.

Having fully described and ascertained the features and objects of my invention, what I consider to be new and desire to have protected by Letters Patent will be pointed out in the appended claims.

What I claim as my invention is:

1. In a telephone system, a subscriber's line, a repeater for said line, means for connecting with said line and for projecting ringing current thereover, and means responsive to said ringing current for disconnecting said repeater from the line.

2. In a telephone system, a line, a telephone on said line, an automatic switch individual to said line, a repeater between said telephone and said switch in the line, a called branch for said line, means for extending a connection to the line via said called branch, and for projecting signaling current thereover, and means responsive to said ringing current for eliminating said repeater from the line.

3. In a telephone system, a line, a plurality of stations on said line, an automatic switch accessible to said line, a ring back switch accessible to said automatic switch, said ring back switch having a code selector individual thereto, a plurality of code interrupter switches accessible to said code selector and to said connector in common, and means for operating the code selector of the

ring back to pick out a code interrupter switch and a particular code on that switch when the call is for another station on the same line and means for operating the connector to pick out a code interrupter without operating the ring back switch when the call is for another line.

4. In a telephone system, a telephone, a line connecting the telephone with a central office, a connector switch associated with said line, said connector switch having a progressively movable wiper, means for controlling said connector to cause said wiper to establish connection with said line, and for transmitting current through said connector and over said wiper to the said line for signaling the telephone, said means also for controlling said connector to cause said wiper to establish connection with another line, a source of ringing current associated with said other line, and means for transmitting current from said source over said other line and over said wiper and through said connector to the said first mentioned telephone line for operating the signal at the telephone.

5. In a telephone system, an automatic switch having means for progressively moving a wiper, a source of ringing current and a signal associated with said switch, and means for building up a connection in one direction from said signal to said generator through said wiper for operating said signal, and also for building up a connection in the other direction from said generator to said signal through said wiper for operating said signal, said means comprising circuit arrangements for operating said switch to select and connect with said generator in the first case, and circuit arrangements for operating said switch to select and connect with said signal in the second case.

6. In a telephone system, an automatic switch having means for progressively moving a wiper, a source of ringing current and a signal associated with said switch, and means for building up a connection from said signal to said generator through said wiper for operating said signal, and also for building up a connection from said generator to said signal through said wiper for operating said signal, the signalling circuit established in the first case extending through the said signal, said wiper, a contact engaged by said wiper, and said generator in the order named, and in the second case extending through said generator, said wiper, another contact engaged by said wiper, and the said signal in the order named.

7. In a telephone system, an automatic switch having means for progressively moving a wiper, a source of ringing current and a signal associated with said switch, and means for building up a connection in one direction from said signal to said generator

through said wiper for operating said signal, and also for building up a connection in another direction from said generator to said signal through said wiper for operating said signal, said signal associated with a telephone and a line for said telephone, an impulse sending device for controlling said automatic switch over said line for selecting said generator to establish said first connection between the signal and the generator, another telephone, a line for said other telephone, an impulse sending device associated with said second telephone for sending impulses over said other line for operating said automatic switch to select said signal for establishing the second connection between said generator and said signal.

8. In a telephone system, a signal, a generator, an automatic progressively movable switch for connecting said signal and said generator at one time by building up a connection from the signal to the generator and at another time for building up a connection from the generator to the signal for establishing a circuit between the generator and the signal for operating the signal, a relay for controlling the first circuit, a relay for controlling the second circuit, and an automatic switch for controlling said relays to cause them to automatically control the signal in accordance with predetermined codes.

9. In a telephone system, subscribers' lines, a connector switch having access to said subscribers' lines, a ring back, said connector switch also having access to said ring back, means whereby the connector may signal any one of said lines when the connector establishes a connection therewith, and means whereby said ring back may signal any one of said lines when the connector establishes a connection with the ring back.

10. In a telephone system, subscribers' lines, a connector switch having access to said subscribers' lines, a ring back, said connector switch also having access to said ring back, means whereby said connector may signal any one of said lines when the connector establishes a connection therewith, and means whereby said ring back may signal any one of said lines when the connector establishes a connection with the ring back, and automatic means for causing said signals to assume code form, said last mentioned automatic means common to both the signaling means of the connectors and in the ring back.

11. In a telephone system, subscribers' lines, a connector switch having access to said subscribers' lines, a ring back, said connector switch also having access to said ring back, means whereby said connector may signal any one of said lines when the connector establishes a connection therewith, and means whereby said ring back may sig-

nal any one of said lines when the connector establishes a connection with the ring back, said last mentioned automatic means comprising a plurality of code interrupters, each
 5 code in each interrupter differing from every other code produced by any of the interrupters.

12. The combination of a ring back in a telephone system and an instantaneous ring cut off connector for extending connection
 10 to said ring back, and means associated with said ring back for transmitting signalling current from the ring back back through the connector to the calling line from which the
 15 connector has been operated to extend connection to the ring back, said connector including means for automatically signalling a called subscriber's line independent of said ring back.

13. In an automatic telephone system the combination of a plurality of ring backs and a rotary connector for establishing connection
 20 with any one of said ring backs, a calling subscriber's line, means for operating said connector from said subscriber's line automatically, means for transmitting ringing
 25 current from the ring back through the rotary connector to the calling line for operating a signal in the calling line, after the
 30 connection has been made with the ring back, subscriber's line, another means for operating said connector to establish connection with the said other subscriber's line as a
 35 connector for operating the signal on the called subscriber's line.

14. In an automatic telephone system the combination of a plurality of ring backs and a rotary connector for establishing connection
 40 with any one of said ring backs, a calling subscriber's line, means for operating said connector from said subscriber's line automatically, means for transmitting ringing
 45 current from the ring back through the rotary connector to the calling line for operating a signal in the calling line, after the
 50 connection has been made with the ring back, another subscriber's line, means for operating said connector to establish connection
 55 with the said other subscriber's line as a called line, means associated with the connector for operating the signal on the called subscriber's line, and means associated with
 said connector for causing said signal to be
 operated in accordance with a predetermined code.

15. In a telephone system, lines, a plurality of stations for each line, automatic
 60 switches accessible to said lines, relays associated with said switches for projecting ringing current to any of said lines, a plurality of code interrupters common to said
 switches, and means for connecting any of
 65 said relays to any of said second code interrupters to signal a desired station on any of

said lines, said switches controlled in one case from one line to signal a station on another line, and in another case from one line to signal another station on the same line.

16. In a party line telephone system, connector switches, ring back switches, ringing
 relays for said switches, auxiliary selecting
 switches for said connectors and ring backs,
 70 a plurality of progressively movable switches common to said auxiliary switches, said progressively movable switches operating automatically when seized to send a code of im-
 75 pulses, and means for operating any auxiliary switch to pick out a particular code on
 80 one of said progressively movable switches and for then causing a ringing relay to be operated in accordance with the code selected to signal a desired subscriber.

17. In a telephone system, a line, a plurality of stations on said line, each provided
 85 with a signal, a ring back, a source of signalling current associated with said ring back, a plurality of circuit interrupters each adapted to close a circuit in accordance with
 90 a code, and means for operating said ring back to select a code and cause the signalling current to be applied to the calling line in accordance therewith.

18. In a telephone system, a calling line,
 95 an automatic connector switch for extending connections from said line to called lines, a generator, a relay for applying said generator to the called line to signal a station
 100 thereon when the called line is other than the calling line, other ringing relays accessible to said connector, and means for selecting an idle one of said other relays when the
 105 called line is also the calling line and for causing said selected relay to be operated to connect said generator to the called line to
 110 signal a station thereon, and a series of switches for operating any of said ringing relays in accordance with a predetermined code.

19. In a telephone system, a line, a telephone on said line, an automatic switch individual to said line, a repeater between said
 115 telephone and said switch in the line, a called branch for said line, means for extending a connection to the line via said called branch, and for projecting signalling current there-
 120 over, and means responsive to said ringing current for eliminating said repeater from the line, said called branch connected to the line at a point between the repeater and the switch.

20. In a telephone system, a line, a telephone on said line, an automatic switch individual to said line, a repeater between said
 125 telephone and said switch in the line, a called branch for said line, means for extending a connection to the line via said called branch, and for projecting signalling current there-
 130 over, and means responsive to said ringing

current for removing said repeater from the path of the ringing current.

21. In a telephone system, a line extending from a subscriber's station to the exchange, means for establishing connection with said line and for connecting ringing current thereto, and means associated with the line at the exchange and responsive to said ringing current, for reducing the impedance of the said line to ringing current.

22. In a telephone system, a subscriber's line, an automatic switch controllable in accordance with the first digit in a called number for extending said line in the direction of a called line, an automatic trunking switch for connecting said line with said first switch, a repeater inserted in the said line between the substation and said trunking switch, a circuit including a wiper of said trunking switch for controlling said first switch, a relay in said repeater for transmitting impulses over said circuit, and a second circuit including the two sides of said subscriber's line in parallel over which said relay is controlled from the substation on said line.

23. In a telephone system, a subscriber's line, an automatic switch controllable in accordance with the first digit in a called number for extending said line in the direction of a called line, an automatic trunking switch for connecting said line with said first switch, a repeater inserted in the said line between the substation and said trunking switch, the said trunking switch being individual to said line, and the said repeater including a voice current repeating coil, a circuit including a wiper of said trunking switch for controlling said first switch, a relay in said repeater for transmitting impulses over said circuit, and a second circuit including the two sides of said subscriber's line in parallel over which said relay is controlled from the substation on said line.

24. In a telephone system, a subscriber's line extending to an exchange and terminating in an automatic trunking switch, an impulse repeater inserted in said line, a connector switch for use in regular exchange calls, a test connector, normal conductors extending from a point between the said repeater and the substation on said line to the banks of said test connector, and other normal conductors extending from a point between the said repeater and said trunking switch to the banks of said regular connector.

25. In a telephone system, a subscriber's line extending to an exchange and there terminating in individual line equipment responsive to calls, a voice current repeating coil inserted in said line, means for completing two different classes of connections to said line, and circuit arrangements such that

the said repeating coil is included in the talking circuit only when connections of a particular class are established.

26. In a telephone system, a subscriber's line, an automatic connector switch for extending a connection to said line, a normally open connection in one of the talking conductors of said line, means individual to said line providing for the passage of signalling current past said open connection, and means responsive when the receiver is removed for closing said connection to complete the talking circuit.

27. In a code ringing party line system, a party line, a connector switch operable to set up a connection with said line, a code ringing machine, auxiliary code selecting mechanism for selecting a code to be transmitted by said machine to signal the desired party on said line, a wipe switching relay in said connector for preparing the signalling circuit, a circuit for said relay closed responsive to the operation of said code selecting mechanism, a "pick up" relay maintained energized throughout the signaling operation for completing the signalling circuit, and a circuit for said last relay completed at the proper time to start the signalling operation at the beginning of the selected code.

28. In a telephone system, a party line, an automatic connector switch for completing a connection to said line, a plurality of code signalling machines, each adapted to signal a different plurality of the parties on said line, an auxiliary switch associated with said connector operable to select the particular code machine which is adapted to signal the plurality of parties including the desired party, and also to select the code corresponding to such desired party, and means for then transmitting ringing current over said party line in accordance with the selected code.

29. In a telephone system, a plurality of code signalling machines, each adapted to signal a line according to a plurality of different codes, a ring-back switch, a party line, a plurality of automatic switches controlled by a calling party on said line for extending connection to said ring-back switch, means for directly operating the ring-back switch to select one of said signalling machines and also to select one of the codes assigned to the selected signalling machine, and means for then transmitting ringing current back over the calling line in accordance with the selected code to signal another party on said line.

30. In a telephone system, a plurality of code signaling machines, each adapted to signal a line according to a plurality of different codes, a ring-back switch, a party line, a plurality of automatic switches controlled by a calling party on said line for

extending connection to said ring-back switch, means for directly operating the ring-back switch to select one of said signalling machines and also to select one of the
 5 codes assigned to the selected signalling machine, a ringing generator, and means for then transmitting ringing current from said generator back through a wiper of said ring-back switch and over the calling line
 10 to signal another party on said line.

31. In a telephone system, a party line, a plurality of code signalling machines, each adapted to signal a different plurality of the parties on said line, a ring-back switch, a
 15 plurality of automatic switches controlled by a calling party on said line for extending connection to said ring-back switch, means for operating the ring-back switch to select the particular signalling machine
 20 which is adapted to signal the plurality of parties including the desired called party, and also to select the ringing code corresponding to such desired party, and means for then transmitting ringing current back
 25 over the calling line in accordance with the selected code.

32. In a code ringing telephone system, a code ringing switch having a plurality of wiper sets, bank contacts for said sets
 30 wired for a plurality of codes, another code ringing switch having a plurality of wiper sets and bank contacts wired for a different plurality of codes, and a code selecting switch having access to all the wiper sets
 35 of both ringing switches.

33. In a code ringing telephone system, a code ringing switch having a plurality of wiper sets, bank contacts for said sets wired for a plurality of codes, another code ringing
 40 switch having a plurality of wiper sets and bank contacts wired for a different plurality of codes, a code selecting switch, wipers for said selecting switch, and a set of bank contacts accessible to said selecting
 45 switch wipers individual to each wiper set of both ringing switches.

34. In a code ringing telephone system, a code ringing switch having a plurality of wiper sets, bank contacts for said sets wired
 50 for a plurality of codes, another code ringing switch having a plurality of wiper sets and bank contacts wired for a different plurality of codes, a connector switch for connecting with a party line, and a code
 55 selecting switch associated with said connector having access to all the wiper sets of both ringing switches.

35. In a code ringing telephone system, a code ringing switch having a plurality of wiper sets, bank contacts for said sets
 60 wired for a plurality of codes, another code ringing switch having a plurality of wiper sets and bank contacts wired for a different plurality of codes, a ring-back apparatus
 65 for handling revertive calls on party lines,

and a code selecting switch associated with said ring-back apparatus having access to all the wiper sets of both ringing switches.

36. In a code ringing telephone system, a set of code ringing relays, a switching
 70 device for energizing said relays at intervals to cause each relay to transmit a different ringing code, a second set of code ringing relays; a second switching device for intermittently energizing the relays of
 75 the second set to transmit a different plurality of ringing codes, a connector switch for connecting with a party line, and a code selecting switch associated with said connector and having access to all the relays
 80 of both sets.

37. In a code ringing telephone system, a set of code ringing relays, a switching device for energizing said relays at intervals
 85 to cause each relay to transmit a different ringing code, a second set of code ringing relays, a second switching device for intermittently energizing the relays of the second set to transmit a different plurality of
 90 ringing codes, a ring-back apparatus for handling revertive calls on party lines, and a code selecting switch associated with said ring-back apparatus and having access to all the relays of both sets.

38. In a code ringing telephone system, a
 95 set of code ringing relays, a switching device for energizing said relays at intervals to cause each relay to transmit a different ringing code, a second set of code ringing relays, a second switching device for inter-
 100 mittently energizing the relays of the second set to transmit a different plurality of ringing codes, a code selecting switch common to both sets of relays, and ringing circuit connections connecting the bank of
 105 said selecting switch with all the relays of both sets.

39. In a telephone system, a party line, a ring-back switch, means including a repeater and a plurality of automatic switches controlled by a calling party on said line for extending
 110 a connection to said ring-back switch, inductive connections in the line circuit at said repeater, an alternating current relay bridged across the line between the repeater and the first of said switches, and means controlled by said relay for completing a metallic ringing circuit past said in-
 115 ductive connections when ringing current is transmitted back over the line from said
 120 ring-back switch.

40. In a telephone system, a repeater, a line switch, a subscriber's line extending through said repeater to said line switch, means in the repeater controlled over said
 125 line when calling for operating said switch to extend the line toward a called line, a connector for extending a connection to said subscriber's line, normal conductors connected to said line between the repeater and
 130

said line switch and constituting the means by which the connector obtains access to the line, inductive connections in the line circuit at the repeater, an alternating current relay bridged across the line between the repeater and the point at which said normal conductors are connected, and means controlled by said relay for completing a metallic ringing circuit past said inductive connections when ringing current is transmitted over said normal conductors from said connector.

41. In a telephone system, a repeater, a line switch, a subscriber's line extending through said repeater to said line switch, a line relay in said repeater controlled over the line, a line relay in said switch controlled from said repeater by said first relay, means for connecting with the line at two points, ahead of the repeater or between the repeater and switch, a cut off relay for disconnecting the repeater line relay when the line is connected with at the first point, and a second cut off relay for disconnecting the switch line relay while leaving the repeater line relay connected when the line is connected with at the second point.

42. In a telephone system, a repeater, an automatic switch, a subscriber's line extending through said repeater to said switch, inductive connections at said repeater dividing the talking circuit into two sections, a line relay in said repeater controlled from the substation on said line over the two conductors of the first section of the talking circuit in parallel, and a line relay in said switch controlled by said first line relay over the two conductors of the second section in series.

43. In a telephone system, a repeater, an automatic switch, a subscriber's line extending through said repeater to said switch, inductive connections at said repeater dividing the talking circuit into two sections, a line relay in said repeater controlled from the substation on said line over the two conductors of the first section of the talking circuit in parallel, said line relay being energized both when the line is calling or is being called, and a line relay in said switch controlled by said first line relay over the two conductors of the second section in series only when the line is calling.

44. In a telephone system, a repeater, an automatic switch, a subscriber's line extending through said repeater to said switch, inductive connections at said repeater dividing the talking circuit into two sections, a line relay in said repeater controlled from the substation on said line over the two conductors of the first section of the talking circuit in parallel, said line relay being energized both when the line is calling or is being called, a line relay in said switch controlled by said first line relay over the two conductors of the second section in series when the

line is calling, and a cut off relay energized when the line is called to disconnect said switch line relay.

45. In a telephone system, a repeater, an automatic switch, a subscriber's line extending through said repeater to said switch, inductive connections at said repeater dividing the talking circuit into two sections, a normally open contact in the second of said sections, a line relay in said repeater energized from the station on said line over the two conductors of the first section in parallel to close said normally open contact, and a line relay in said switch energized over the two conductors of the second section in series when said normally open contact is closed.

46. In a telephone system, a repeater, an automatic switch, a subscriber's line extending through said repeater to said switch, inductive connections at said repeater dividing the talking circuit into two sections, a line relay in said repeater, a ringer and a calling device at the station on said line, a circuit for said line relay including the two conductors of the first of said sections in parallel, the two coils of said ringer in parallel, and said calling device, a line relay in said switch, and a circuit for said switch line relay including contacts on the repeater line relay and the two conductors of the said second of said sections in series.

47. In a telephone system, an automatic connector switch, a subscriber's line, a branch of said line terminating in the bank of said connector, said branch comprising two sections inductively connected by means of a repeating coil, means for operating said connector to connect with said line by way of said branch, means in said connector for connecting a source of ringing current to said branch, and a relay individual to said line for joining said sections over a path excluding said repeating coil to permit ringing current from said source to reach the substation on said line.

48. In a telephone system, a subscriber's line, means including a connector switch for extending a connection to said line, a repeating coil included in the connection between the said line and the wipers of said connector, means for applying signalling current to said line from the said connector, and means individual to said line for temporarily providing a direct path for the signalling current excluding said repeating coil.

49. In a telephone system, a subscriber's line, means including a connector switch for extending a connection to said line, a repeating coil included in the connection between the said line and the wipers of said connector, means for applying signalling current to said line from the said connector, and a relay individual to said line

for closing a shunt circuit around said repeating coil to provide a direct path for the signalling current.

50. In a telephone system, a line, a repeater individual to said line, a connector for seizing said line, means associated with said connector for applying ringing current to the line when called, a pair of relays associated with said repeater, a ring cut off relay included in the ringing circuit,

means responsive to ringing on the line for making one relay of said pair operative to disconnect said repeating coil and to complete the ringing circuit, and the other relay operative on the response of the called subscriber to complete an operating circuit for said cut off relay.

Signed by me at Chicago, Cook County, Illinois, this 22d day of May, 1919.

JOHN WICKS.